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A NEW SPECIES OF *HETEROSPILUS* (HYMENOPTERA: BRACONIDAE) ASSOCIATED WITH THE DEATHWATCH BEETLE, *HEMICOELUS GIBBICOLLIS* (LECONTE) (COLEOPTERA: ANOBIIDAE)

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Abstract.—*Heterospilus luridostigmus* Marsh, a new braconid wasp species, is described. This wasp was found in abundance emerging from pieces of Douglas-fir, *Pseudotsuga menziesii* (Mirbel) Franco, from an outdoor wooden deck in Daly City, California, that was infested with the deathwatch beetle, *Hemicoelus gibbicollis* (LeConte). Adult *Heterospilus luridostigmus* began emerging in May 1999 followed by emergence of *Hemicoelus gibbicollis* about 4 weeks later. Both species continued to emerge throughout the summer of 1999 and were the only species found in the boxes. During the summer of 2000, rearing boxes containing infested wood from the original source and from several homes in Alameda County, California yielded both *Heterospilus luridostigmus* and *Hemicoelus gibbicollis* as well as *Odontocolon polymorphum* Cushman (Hymenoptera: Ichneumonidae). Although we found no direct evidence of parasitism of *Hemicoelus gibbicollis*, wasps in the genera *Heterospilus* and *Odontocolon* are known to parasitize anobiids, and *Heterospilus flavicollis* (Ashmead) is a parasitoid of an eastern deathwatch beetle species, *Hemicoelus carinatus* (Say). This suggests that *Heterospilus luridostigmus* is a parasitoid of *Hemicoelus gibbicollis*. The synchrony of emergence of these two species during both years also is indicative of a host/parasitoid relationship between the two species. The discovery of a new insect species in a heavily populated urban environment is noteworthy and serves as a vivid reminder of the untold number of insect species that have yet to be discovered.

Key Words.—Insecta, Braconidae, Anobiidae, Ichneumonidae, deathwatch beetle, parasitoid, emergence hole.

The genus *Heterospilus* Haliday is a member of the braconid subfamily Doryctinae. It can be identified by using the key to New World genera of Braconidae (Marsh 1997). In North America the genus is easily distinguished from the other doryctine genera by the reduction of fore wing vein 2RS (Fig. 1), which is always desclerotized and often completely absent, and the presence of a stigma in the hind wing of the male (not pictured). The small genus *Pioscelus* Muesebeck and Walkley, which also has fore wing vein 2RS absent, is separated by having no basal tubercle on the hind coxa. *Heterospilus* is the most species-rich genus in the Doryctinae, with an estimated 200 species in the Nearctic Region and 300 in the Neotropical Region. Most of these species are undescribed and the genus is badly in need of revision.

All *Heterospilus* are idiobiont ectoparasitoids (Shaw & Huddleston 1991) and this genus also has the most diversified host range in the Doryctinae. Species of the genus parasitize a very wide range of endophytic, mostly stem-boring, hosts

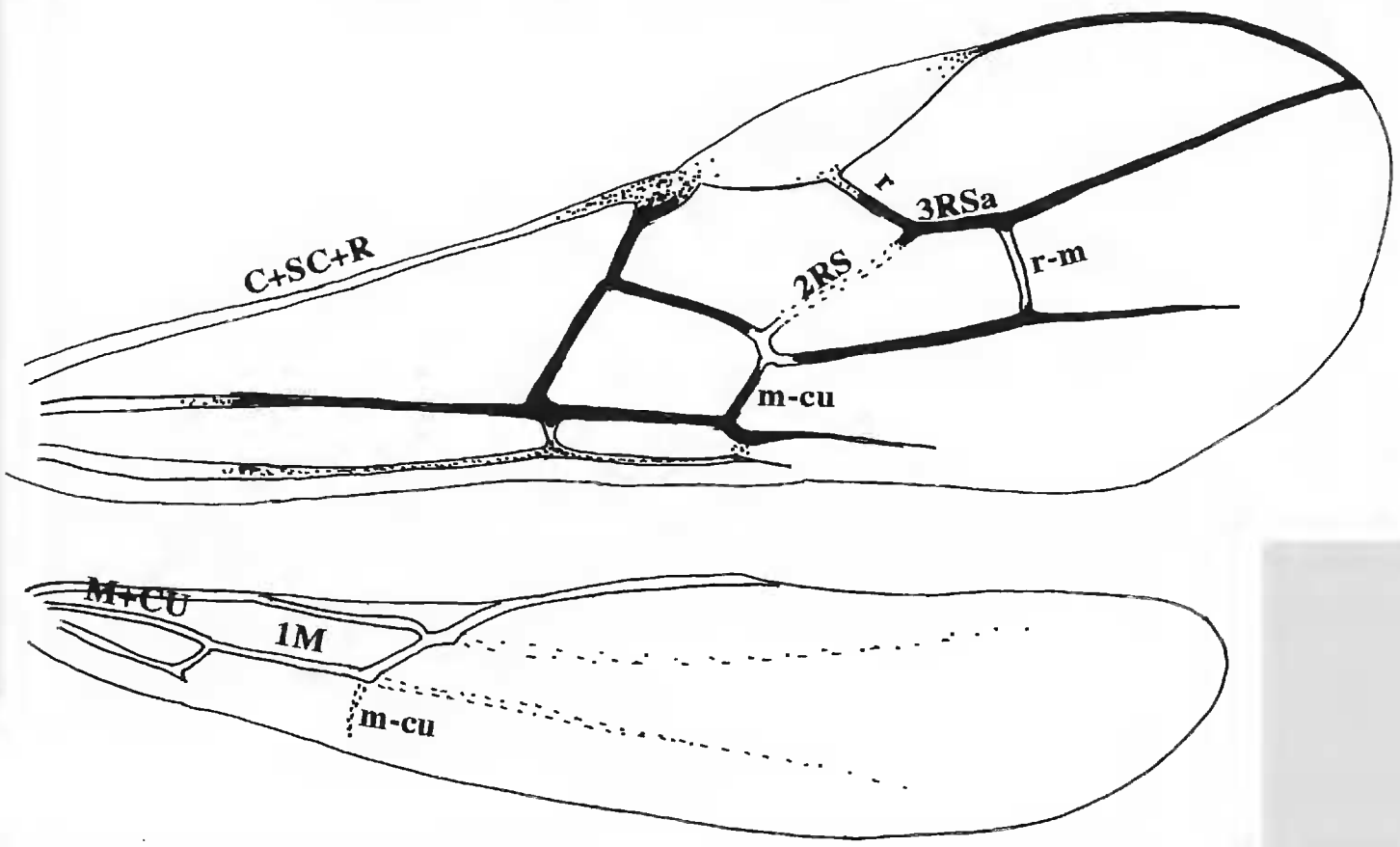


Figure 1. Wing venation of female *Heterospilus luridostigmus,* n. sp.

(Marsh 1982, Shaw 1995) including those in the coleopteran families Anobiidae, Bostrichidae, Bruchidae, Buprestidae, Cerambycidae, Curculionidae, Languriidae, Mordellidae and Scolytidae, and those in the lepidopteran families Gelechiidae, Incurvariidae, Pyralidae and Tortricidae. Several other species have been reared from other hosts including stem-boring symphytan Hymenoptera. A few species are known to attack pemphredonine sphecid wasps (Marsh & Melo 1999).

In North America, five species have been recorded from Anobiidae, including the new species described in this paper whose authorship is attributed solely to P. M. Marsh. V. R. Lewis obtained beetle-infested wood was obtained by V. R. Lewis. Wasps and beetles were reared and collected by V. R. Lewis and B. J. Cabrera. S. J. Seybold and V. R. Lewis are principal investigators on a deathwatch beetle, *Hemicoelus gibbicollis* (LeConte), pheromone project that includes the work presented in this paper.

Heterospilus luridostigmus Marsh, NEW SPECIES

Types.—Holotype, female. CALIFORNIA: SAN MATEO CO.: Daly City, 393 Oriente St., Oct. 1998, V. R. Lewis, ex *Pseudotsuga menziesii* (Mirbel) Franco boards from wooden deck. Deposited in NMNH, Washington, D.C.

Paratypes.—CALIFORNIA: same data as holotype, 41 females, 7 males. Deposited in the California Academy of Sciences, San Francisco, NMNH, Washington, D.C. and the University of Minnesota Insect Collection, University of Minnesota, St. Paul.

Description:—Female. Color: head, mesosoma and metasoma dark brown; scape, pedicel and basal flagellomeres light brown, apical flagellomeres dark brown; fore and middle legs yellow, femora marked with raised brown spot dorsomedially, tibiae marked with brown; hind leg with coxa and femur brown, trochanters yellow, tibia yellow marked with brown, tarsus yellow; wings slightly dusky, veins brown, stigma and vein C+SC+R light yellow, stigma sometimes nearly white. Body size: 2.5–

4.0 mm. Head: face smooth and with dense long gold hair, frons and vertex transversely striate (Fig. 2), occasionally weakly so and nearly smooth; temple smooth; malar space two-thirds eye height; ocell-ocular distance about 3 times diameter of lateral ocellus; occipital carina not meeting hypostomal carina; 19–23 antennomeres. Mesosoma: pronotum rugose, with dense gold hair along weak pronotal groove; mesonotal lobes (Fig. 3) coriaceous, rugose along notauli, notauli scrobiculate, meeting before scutellum in rugose area with longitudinal short carinae, dense long gold hair along notauli; scutellum smooth; mesopleuron smooth, subalar area carinate, sternaulus deep and longitudinally striate, dense long gold hair on subalar area and along posterior edge; propodeum (Fig. 4) rugose, basal median areas smooth, median carina and areola distinct, dense gold hair laterally. Legs: hind coxa with small but distinct antero-ventral basal tubercle or tooth. Wings (Fig. 1): fore wing vein r as long as or slightly longer than 3RSa, vein 2RS indicated by weak infuscate line, vein r-m not sclerotized but distinct, vein m-cu arising distad from vein 2RS; hind wing vein M+CU longer than vein 1M, vein m-cu a distinct infuscated line. Metasoma (Fig. 5): first tergum longitudinally carinate, length slightly less than apical width, median raised area distinct, defined by carinae only on basal half; second tergum longitudinally carinate; third tergum smooth with carinate area across basal half; remainder of tergum smooth; ovipositor about two-thirds length of metasoma.

Male.—Essentially as in female; body size 1.5–3.0 mm; 17–20 antennomeres; hind wing with elongate stigma.

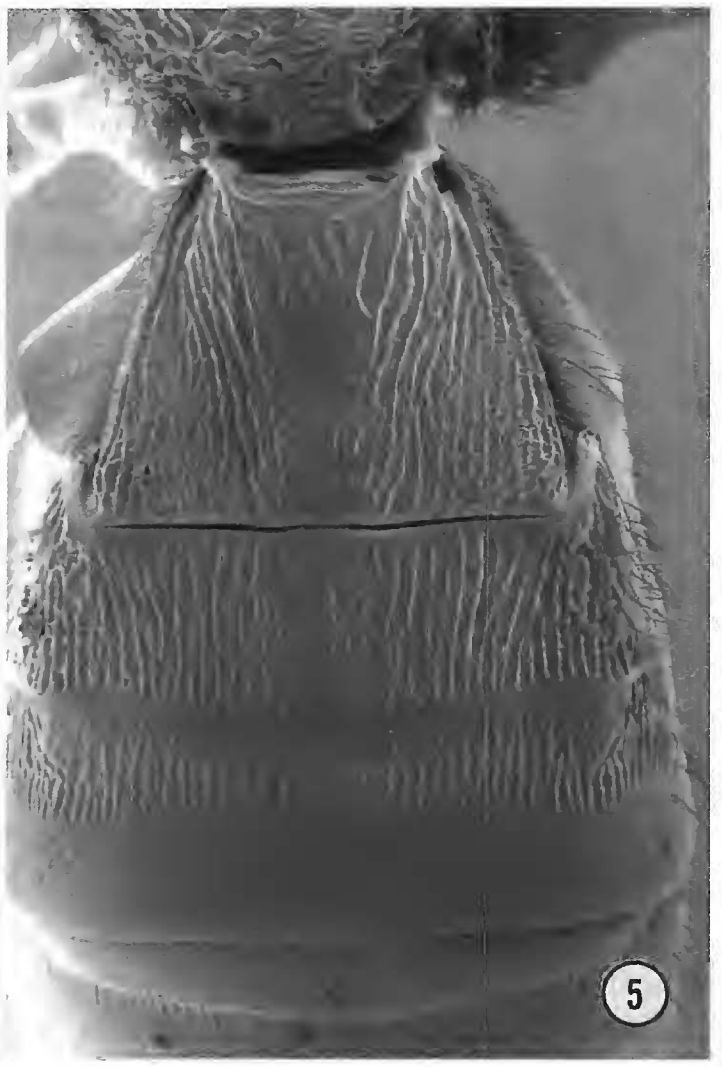
Biology.—Associated with adults of *Hemicoelus gibbicollis* (LeConte) (Coleoptera: Anobiidae) infesting Douglas-fir boards from a backyard deck. See details of biology below.

Comments.—This species is distinctive by its light yellow to almost white stigma in the fore wing and by vein M+CU in the hind wing being longer than vein 1M. Although this hind wing venation is not typical for the genus, in all other characters the specimens are clearly congeneric. This species is easily distinguished from *H. baeticatus* (Provancher), *H. flavicollis* (Ashmead) and *H. longicauda* (Ashmead), which are also recorded as parasitoids of anobiids, by having the ovipositor shorter than the metasoma. This species has a similar ovipositor length to *H. anobiidivorus* Muesebeck but differs in the light stigma, completely carinate second metasomal tergum, shorter first metasomal tergum and longer antenna.

Etymology.—The specific name is from the Latin *luridus* meaning pale yellow in reference to the pale yellow or almost white stigma in the fore wing.

Biology and Observations

Wood Collection.—Wood [Douglas-fir, *Pseudotsuga menziesii* (Mirbel) Franco] infested with the deathwatch beetle, *Hemicoelus gibbicollis,* was collected in October 1998 from the deck of a home in Daly City, San Mateo County, California. The wood was cut into lengths of approximately 20–50 cm and stored at ambient temperature and relative humidity in a greenhouse at the University of California, Berkeley, in two wooden emergence boxes (122 × 122 × 122 cm) or in 58 liter plastic storage boxes with 5-cm diameter screen-covered holes in each end for ventilation. Wood moisture content was monitored with a moisture meter (Protimeter Timbermaster, Protimeter Ltd., Marlow Bucks, England) and the wood was watered as needed to maintain approximately 14–17% moisture content (Suomi & Akre 1992a, b). Additional pieces of infested wood (predominantly *P. menziesii*) were collected in October, 1999 from several homes in Alameda County, California and kept outdoors on the premises of the University of California, Forest Products Laboratory, Richmond, California. In June 2000, this wood was also cut and stored in plastic storage boxes as previously described.



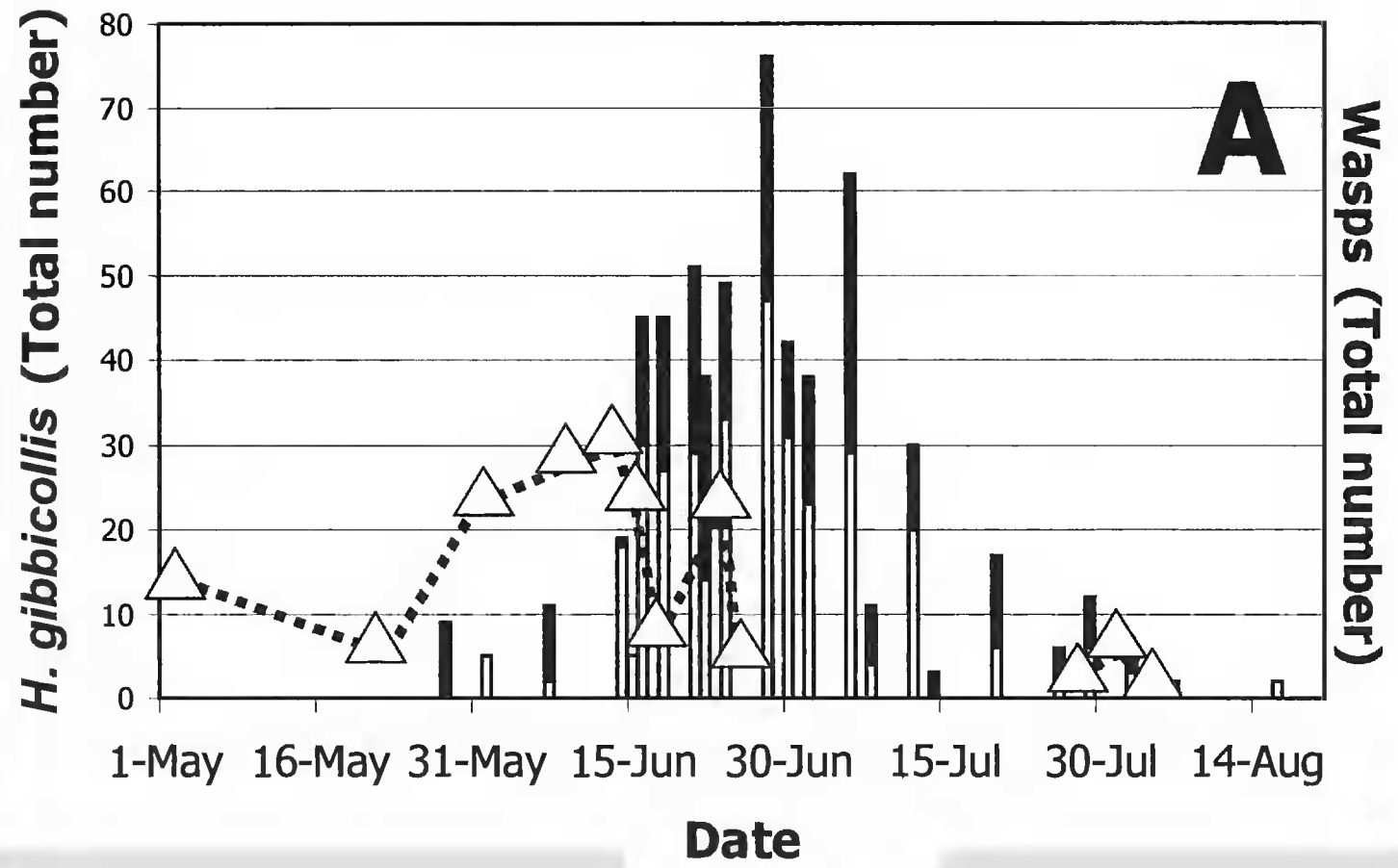
Figures 2–5. Morphological characters of *Heterospilus luridostigmus*, n. sp. Figure 2. Vertex and frons. Figure 3. Mesonotum. Figure 4. Propodeum. Figure 5. Metasomal terga 1–4.

Beetle and Wasp Emergence, 1999.—Boxes were checked occasionally for adult *Hemicoelus gibbicollis* (needed for extracting sex pheromone and for behavioral assays) beginning in April 1999. *Heterospilus luridostigmus* appeared unexpectedly in the wooden emergence boxes on 3 May and continued to emerge through 2 Aug (Fig. 6A). The exact date of initial emergence is unknown because the boxes were not examined on a regular basis. The first *Hemicoelus gibbicollis* adults were found on 28 May with the exact date of emergence also unknown. The last adults were collected on 16 August. This emergence was in agreement with Suomi & Akre (1993a, b) who stated that normal emergence occurs during June, July, and August. We collected a total of 584 beetles (336 alive, 57.5% survival) and 179 wasps.

Beetle and Wasp Emergence, 2000.—Beetles and wasps were first collected on 15 June. The number of emerged adults of both species was considerably lower than in 1999 (Figs. 6A and 6B), possibly because of the different collection source, differences in the host wood, or because of exposure to sub-optimal environmental conditions prior to rearing. The wood had been kept outdoors for seven months before it was cut and placed in the rearing boxes. A total of 218 beetles (132 alive, 60.6% survival) and 32 wasps were collected. Several adult male and female *Odontocolon polymorphum* Cushman (Hymenoptera: Ichneumonidae) were collected in addition to *Heterospilus luridostigmus.*

Possible Parasitism of Hemicoelus gibbicollis.—The doryctine b raconids are generally considered to be ectoparasitoids of wood-boring beetle larvae (Marsh 1979). However, Suomi & Akre (1992a, b, c; 1993a, b) did not mention parasitoids in their detailed descriptions of *Hemicoelus gibbicollis* biology and ecology. Furthermore, we did not directly observe wasps emerging from any life stage of *Hemicoelus gibbicollis* or from the wood and dissection of several small pieces of wood did not yield any parasitized larvae. The need for large numbers of adult *H. gibbicollis* made us reluctant to conduct a more thorough search that would have required destruction of more beetle-infested wood. However, we believe that *Heterospilus luridostigmus* is a parasitoid of *Hemicoelus gibbicollis* because: 1) adults of both species appeared in our rearing boxes in relative synchrony during both years; 2) a broad range of hole diameters was observed on the surface of the infested wood; and 3) other species of *Heterospilus* are idiobiont ectoparasitoids of wood-destroying anobiids (e.g., *Heterospilus flavicollis* (Ashmead) on *Hemicoelus carinatus* (Say) [Drooz 1985], the most common wood-infesting deathwatch beetle in the northeastern United States [Simeone 1962], and *Heterospilus longicauda* (Ashmead) on *Xyletinus peltatus* (Harris) [Williams et al. 1979]).

The only two live insect species to appear in 1999 in our rearing boxes were *Heterospilus luridostigmus* and *Hemicoelus gibbicollis.* Both species were collected again in 2000 from rearing boxes containing wood that was collected both years. In 1999, adult *Heterospilus luridostigmus* were first observed approximately four weeks before the first emergence of *Hemicoelus gibbicollis* while the following year both species were first found on the same day. Peak emergence of both species was nearly synchronous in 1999, with the largest number of wasps emerging approximately two weeks before the largest number of beetles emerged (Fig. 6A). A similar trend was observed the following summer (Fig. 6B). The observation that *Heterospilus luridostigmus* preceded *Hemicoelus gibbicollis* in



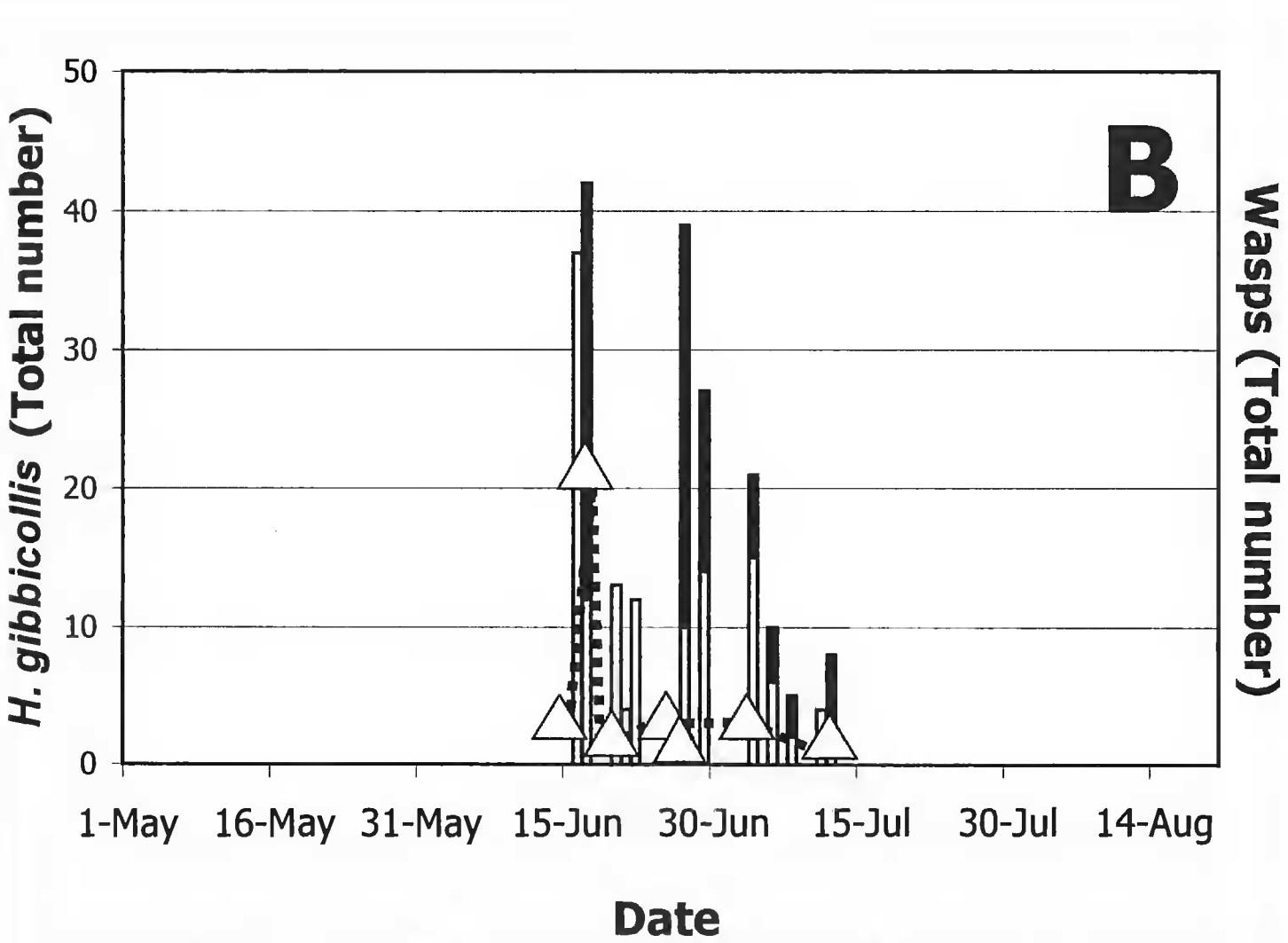


Figure 6. Emergence of beetles and wasps. A. *Hemicoelus gibbicollis* (LeConte) (bars), and *Heterospilus luridostigmus* Marsh (line), summer 1999. □ Live beetles, ■ Dead beetles, △ Live wasps. B. *Hemicoelus gibbicollis* (LeConte)(bars), and *Heterospilus luridostigmus* Marsh and *Odontocolon polymorphum* Cushman (line), summer 2000. □ Live beetles, ■ Dead beetles, △ Live wasps.

emergence in 1999 but not in 2000 might be attributed to laboratory worker inexperience, as both species are difficult to find amongst the pieces of wood in the rearing boxes. *Hemicoelus gibbicollis* is especially difficult to locate because emerged adults spend large periods of time seeking refugia in emergence holes. We also expected a much larger emergence of *Hemicoelus gibbicollis* during the summer of 2000. Dissection of several infested pieces of wood in mid-August of that year yielded beetle larvae of mixed size and, presumably, age, indicating that the infestations were still active. We speculate that the lower number of emerged beetles and the shorter emergence period during the second year were partly a result of parasitism. Williams et al. (1979) found that *Heterospilus longicauda* (Ashmead) accounted for 1.3–36.6% mortality of the potential population of their anobiid host, *X. peltatus.*

We frequently observed small emergence holes in the infested wood, presumably made by *Heterospilus luridostigmus,* adjacent to much larger and more abundant emergence holes, presumably made by *Hemicoelus gibbicollis* (Fig. 7) (*Hemicoelus gibbicollis* is considerably larger than *Heterospilus luridostigmus* in cross-sectional area). Williams et al. (1979) reported that *Heterospilus longicauda* emergence holes were about one-eighth the size of *X. peltatus* emergence holes, that the wasp oviposited through the wood and onto the host larvae, and assumed there was one parasite larva per host. However, we measured holes (n = 434) from several pieces of wood collected in 1999 and instead of an expected bimodal distribution we obtained an approximately normal distribution ranging from 0.46 to 2.15 mm in diameter (Fig. 8). The lack of a distinct separation among emergence hole diameters prevents us from reporting species-specific emergence hole size ranges at this time. In contrast to Williams et al. (1979), our minimum emergence hole sizes all exceeded one-eighth of the maximum hole sizes. Our sample of emergence holes probably also contained holes made by *O. polymorphum.*

The appearance of *O. polymorphum* from our rearings in 2000 reveals the possible existence of other parasitoids of *Hemicoelus gibbicollis.* The wood in the rearing boxes had been lying outdoors for seven months, thus making larvae and pupae of *H. gibbicollis* within the wood readily accessible to attack by *Heterospilus luridostigmus* and other opportunistic natural enemies. Alternatively, *Heterospilus luridostigmus* and *O. polymorphum* may have located and colonized *Hemicoelus gibbicollis* while the wood was still in the structures from which it was removed. *Odontocolon polymorphum* has been collected in Oregon, Washington, and British Columbia and has been associated with two wood-infesting anobiid species (one unidentified, the other *Ptilinus basalis* LeConte) (Carlson 1979).

This paper represents the first report of *O. polymorphum* associated with *Hemicoelus gibbicollis.* Ovipositor length and examples of other xoridine ichneumonids (Townes et al. 1960) suggest that *O. polymorphum* is ectoparasitic and oviposits through the wood surface onto larvae and pupae of *H. gibbicollis.*

Whether *H. gibbicollis* is an obligate or facultative host for both wasp species remains to be determined. Although there is strong evidence for a host/parasitoid relationship between *Hemicoelus gibbicollis* and *Heterospilus luridostigmus,* direct observation of wasp oviposition behavior, emergence of adult wasps from the host or infested wood, detection of parasitized beetle larvae or larval beetle

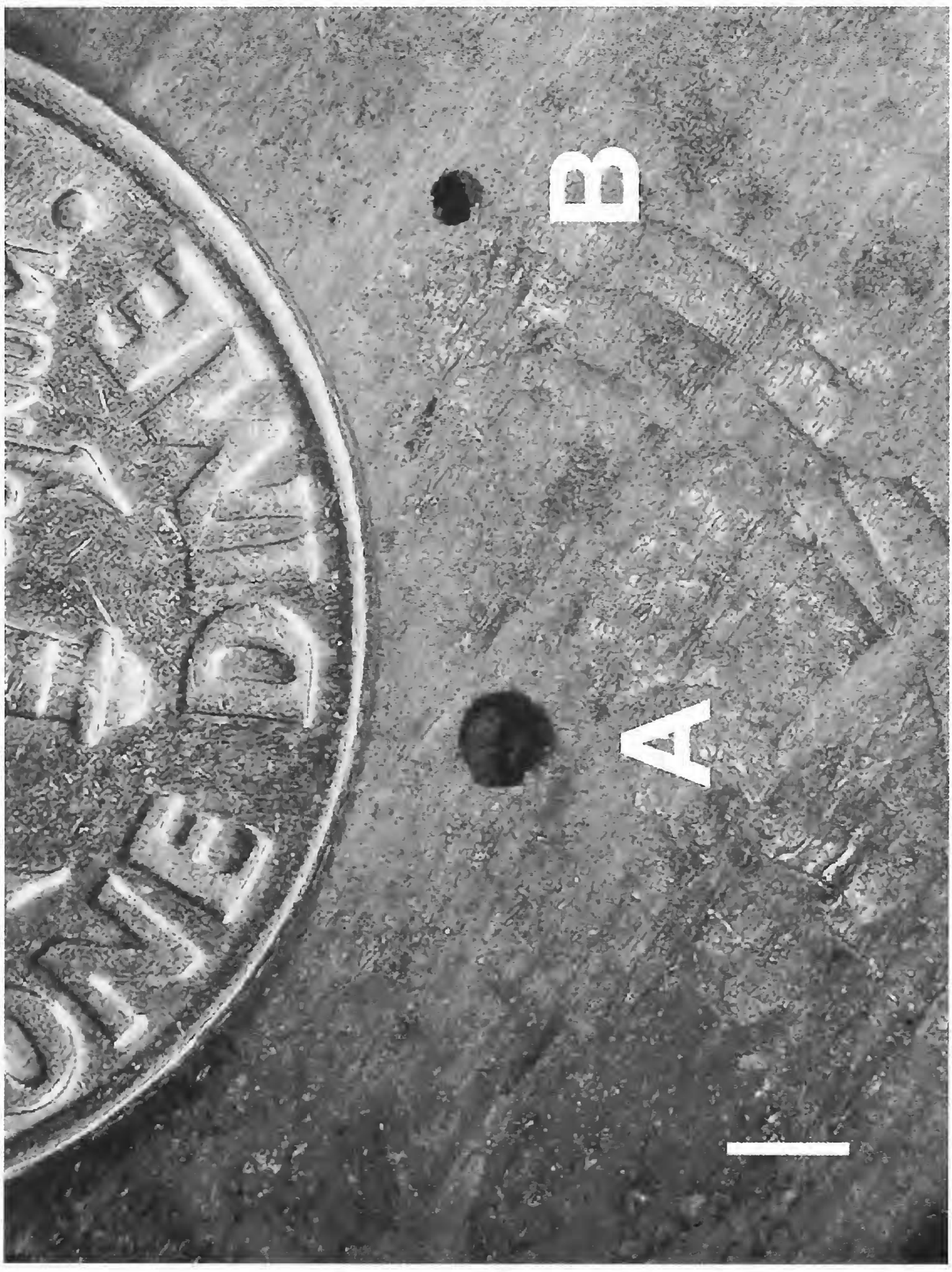


Figure 7. Adult emergence hole of *Hemicoelus gibbicollis* (LeConte) (A) and suspected emergence hole of *Heterospilus luridostigmus* Marsh (B). Bar = 1 mm.

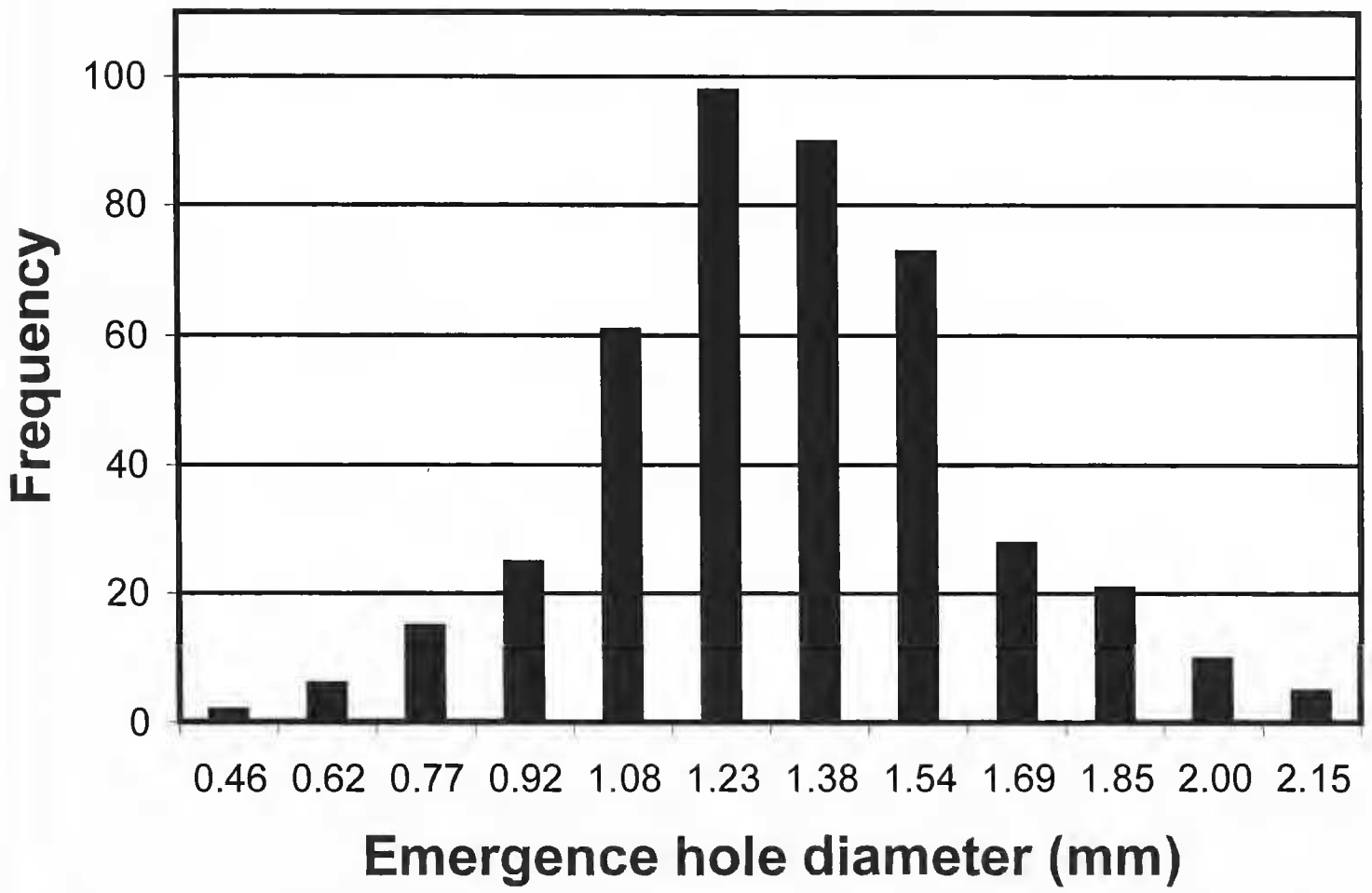


Figure 8. Size distribution of emergence holes (n = 434) of *Hemicoelus gibbicollis, Heterospilus luridostigmus,* and *Odontocolon polymorphum* measured from several pieces of infested *Pseudotsuga menziesii,* collected in 1999 in Alameda Co., California.

head capsules present in wasp cocoons is needed to confirm the existence of this proposed ecological relationship.

Finally, it is noteworthy that a new insect species has been found in an urban environment. This discovery, in a heavily populated area and in close association with human dwellings, is a vivid reminder of the tremendous diversity of the Insecta and of the untold number of insect species that have yet to be discovered.

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